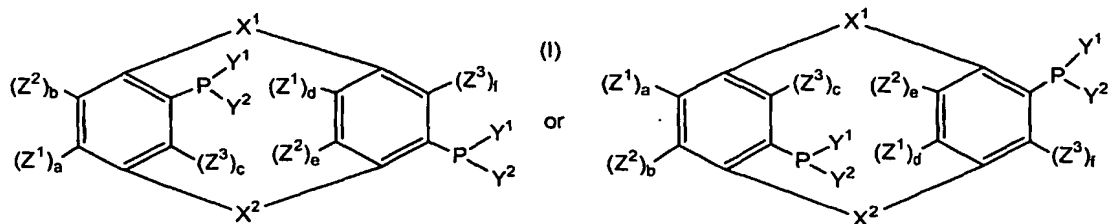


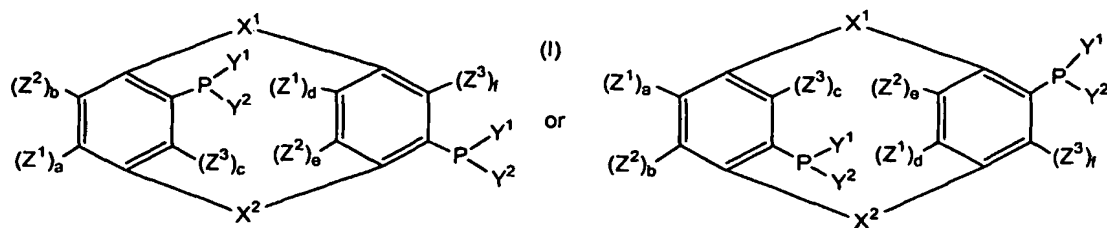
Claims.

1. A substituted paracyclophane of formula (I)

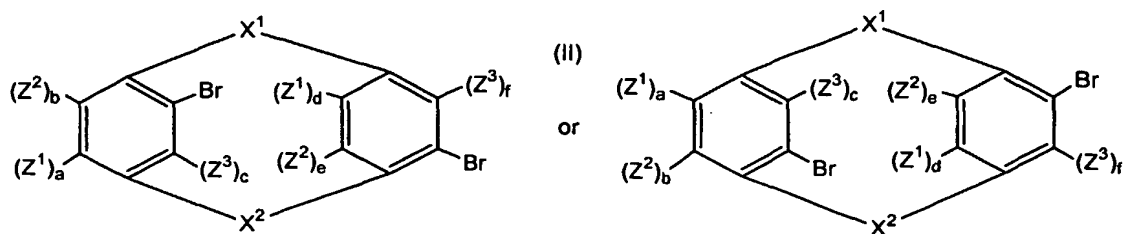


wherein  $X^1$  and  $X^2$  are linking groups comprising between 2 to 4 carbon atoms,  $Y^1$  and  $Y^2$  are selected from the group consisting of hydrogen, halide, oxygen, nitrogen, alkyl, cycloalkyl, aryl or heteroaryl,  $Z^1$ ,  $Z^2$  and  $Z^3$  are substituting groups that optionally contain functional groups, a, b, c, d, e and f are 0 or 1 and  $a + b + c + d + e + f = 1$  to 6.

2. A substituted paracyclophane according to claim 1 wherein  $X^1$  and  $X^2$  are both  $-C_2H_4-$ .
3. A substituted paracyclophane according to claim 1 or claim 2 wherein  $Z^1$ ,  $Z^2$  or  $Z^3$  are substituting groups selected from C1-C30 branched or linear alkyl or phenyl, naphthyl or anthracyl groups.
4. A substituted paracyclophane according any one of claims 1 to 3 wherein  $Z^1$ ,  $Z^2$  or  $Z^3$  are substituting groups comprising one or more functional groups selected from halide, hydroxyl, alkoxy, carbonyl, carboxyl, anhydride, methacryl, epoxide, vinyl, nitrile, nitro, sulphate, sulphonyl, mercapto, amino, amine, imine, amide and imide.
5. A substituted paracyclophane according to any one of claims 1 to 4 wherein  $a + b + c + d + e + f = 1$  or 2.
6. A substituted paracyclophane according to anyone of claims 1 to 5 wherein  $a + b + c = 1$  and / or  $d + e + f = 1$ .
7. A method for preparation of a substituted paracyclophane of (I) by,



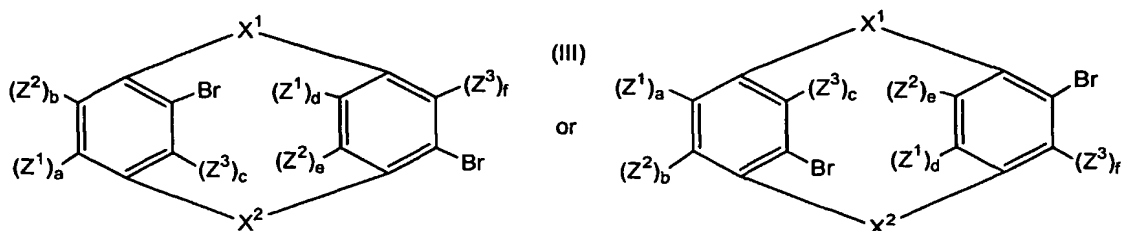
(a) performing a substitution reaction on a pseudo-ortho dibromoparacyclophane to form an intermediate substituted pseudo-ortho dibromoparacyclophane of formula (II), and



(b) reacting the substituted pseudo-ortho dibromoparacyclophane with a phosphorus compound comprising  $P(Y^1Y^2)$ , wherein  $X^1$  and  $X^2$  are linking groups comprising between 2 to 4 carbon atoms,  $Y^1$  and  $Y^2$  are selected from the group consisting of hydrogen, halide, oxygen, nitrogen, alkyl, cycloalkyl, aryl or heteroaryl,  $Z^1$ ,  $Z^2$  and  $Z^3$  are substituting groups that optionally contain functional groups, a, b, c, d, e and f are 0 or 1 and  $a + b + c + d + e + f = 1$  to 6.

8. A method according to claim 7 wherein the substitution reaction is a Lewis-acid mediated electrophilic substitution.

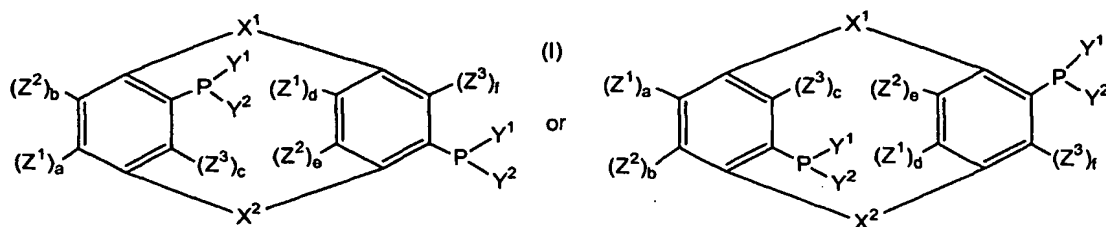
9. A substituted pseudo-ortho dibromoparacyclophane of formula (III)



wherein  $X^1$  and  $X^2$  are linking groups comprising between 2 to 4 carbon atoms,  $Z^1$ ,  $Z^2$  and  $Z^3$  are substituting groups at least one of which comprises a functional group selected from hydroxyl, alkoxy, carboxyl, anhydride, methacryl, epoxide, vinyl, nitrile, nitro, sulphate, sulphonyl, mercapto, sulphide amino, amine, imine, and imide, a, b, c, d, e and f are 0 or 1 and  $a + b + c + d + e + f = 1$  to 6.

10. A substituted pseudo-ortho dibromoparacyclophane according to claim 9 wherein the functional group is a carboxylic acid functional group or an amino functional group.

11. A metal complex comprising the reaction product of a metal compound and a substituted paracyclophane of formula (I)



wherein  $X^1$  and  $X^2$  are linking groups comprising between 2 to 4 carbon atoms,  $Y^1$  and  $Y^2$  are selected from the group consisting of hydrogen, halide, oxygen, nitrogen, alkyl, cycloalkyl, aryl or heteroaryl,  $Z^1$ ,  $Z^2$  and  $Z^3$  are substituting groups that optionally contain functional groups, a, b, c, d, e and f are 0 or 1 and  $a + b + c + d + e + f = 1$  to 6.

12. A metal complex according to claim 11 wherein the metal compound is a compound of palladium (Pd), platinum (Pt), rhodium (Rh), iridium (Ir) or ruthenium (Ru).
13. A metal complex according to claim 11 or claim 12 wherein the substituted paracyclophane (I) is substantially enantiomerically-pure.
14. A metal complex according to any one of claims 11 to 13 wherein the metal complex is supported on a solid support.
15. The use of a metal complex according to any one of claims 12 to 14 as a catalyst in an asymmetric hydrogenation reaction.
16. The use of a metal complex according to any one of claims 12 to 14 as a catalyst for reactions selected from the list consisting of carbon-carbon coupling reactions, the enantioselective isomerization of olefins, asymmetric hydroboration reactions, asymmetric cyclisation of olefinic aldehydes, asymmetric arylation and alkylation reactions and the amination of aryl halides (Hartwig-Buchwald reaction).